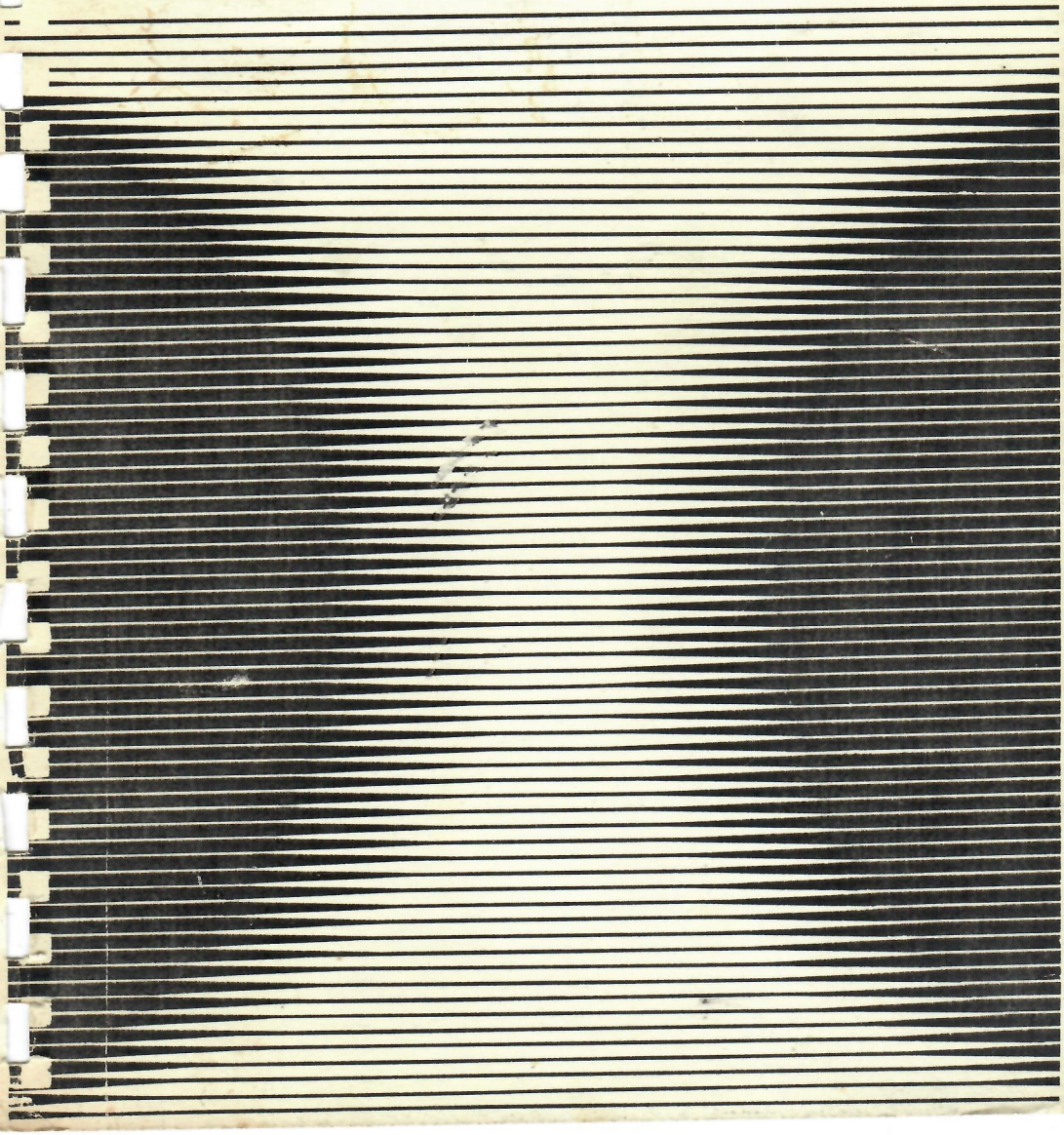
BBC microcomputer system

DISC SYSTEM

USER GUIDE



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DISC SYSTEM
USER GUIDE

Brian Ward

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Introduction

Before you start using the Disc File system, check that you have all the following items:

— A disc drive with ribbon cable and power cable
— A filing system utilities disc
— A model 'B' microcomputer with the disc interface
— (All disc interfaces are fitted by dealers. There are no user-serviceable parts in the BBC microcomputer or the disc unit.)
— A dual disc should consist of two disc drives connected by a ribbon cable and a power cable. One of the drives should also have a similar ribbon cable and a power cable for connecting to the BBC computer.

If any of the necessary items are missing then contact your supplier, quoting the order number given to you when you placed your order. The number also appears on the dispatch label.

Notes of errors and suggestions for improvement will be gratefully received by the author. Comments should be sent to:

Brian J. Ward
Acorn Computers Ltd
Fulbourn Road
Cherry Hinton
Cambridge CB1 4JN

1 What is a disc system?

If you have never used a computer with discs before there are one or two new concepts which you need to learn.

A disc drive

As you probably know, computers have internal memory called Random Access Memory or RAM. When you type in your program it is stored in RAM. However, when you switch off the computer, everything stored in RAM is lost, so if you need the program again, you have to re-type it. To overcome this problem the computer must be able to transfer the contents of RAM into some form of permanent or 'non-volatile' storage before you switch it off. The User Guide which comes with your BBC computer describes how to use a cassette recorder for this purpose. Transferring a program from RAM to tape is called `saving` it, transferring from tape back to RAM is called `loading` it. The disadvantages of using tape are:

(a) The process of saving and loading is quite slow.
(b) You need to keep track of where on the tape each piece of information is, so that you do not record over it.
(c) You have to wind the tape to the right place yourself.
(d) Winding from one end of the tape to the other is slow.
(e) It is not possible to wind the tape to a particular point accurately.

A disc system does not have these disadvantages.

To help you to understand how a disc system works, we shall draw some comparisons with a filing cabinet. A disc system always includes at least one disc drive. The BBC computer's disc drives are buff coloured metal boxes approximately 15.5cms × 9cms × 24cms. The front of a disc drive is black. On the front is the BBC Owl, a small red light and a spring flap called the disc drive door. The door can be opened or closed, but must be closed while the disc drive is supposed to be working. These are floppy disc drives, as distinct from fixed disc drives, which you may have heard of. The disc drive can be compared to an empty filing cabinet with no drawers in it yet.

NB The back of the disc drive has some cables coming out of it. These are to connect to the computer. If you have a dual-drive, similar cables will also be used to connect the two drives together. (see diagram 1, page 12).

Just as a filing cabinet is pretty useless without drawers, so a disc drive cannot do much without discs. The disc used with the BBC computer are 5.25" soft-sectored floppy discs. They can be inserted and removed from the disc drive via the slot in the front. There is one right way of inserting them, and several wrong ways. As in the case of the filing cabinet drawers, putting them in the wrong way is a waste of time. Diagram 1 on page 12 shows the correct way to insert a disc. To reinforce this:

Discs should be inserted with the label upwards and with the edge nearest the label in your hand. The edge opposite to the label and the read/write slot of the disc go in first.

Diagram 2 shows and names the various parts of a disc and chapter 3 'Discs' gives more detailed information about them. The discs hold the information. You can change the discs in the drive just like you can change the cassettes in a cassette recorder. So you can use lots of discs to store information, but you can only read the information from one disc at a time. Just as a music cassette may have several different songs on it, a disc may have different groups of information and these are called 'files'. Files can have any information in them. Typical examples would be one of your programs or some data generated by a program which you wish to keep.

Returning again to the comparison with a filing cabinet, opening a drawer and throwing all the papers into it at random would make it difficult to find them again. To solve this problem, people usually put dividers into a filing cabinet drawer, and often these are labelled alphabetically. The result is that the information is grouped so that you can find it again quickly. The same principle is followed when the computer puts information on to a disc. When you first buy discs, they are blank – like empty drawers. Before the computer can put any information on them, the discs must first be prepared by having marks put on them, which divide the discs into sectors. 'Sectors' is the name given to a set of equal divisions created on the disc by the computer. (See diagram 5). This operation is called 'Formatting' and is fully described in chapter 6.

When you insert the disc into the disc drive and close the drive door a rotating boss engages with the central hole in the disc and spins the magnetic disc inside its protective jacket. (Do not confuse the protecting jacket with the disk envelope, see diagram 2) In order to read or write information on to the disc the disc drive has a 'Read-Write Head'. This head is designed to move in and out along the 'Head Slot' in the disc jacket. This head actually rests on the surface of the magnetic disc as it rotates inside the jacket. When you want to read some of the information on the disc, you give the

computer the name of the file containing that information. The computer will move the read/write head to the sector on the disc where the start of the information in the named file is recorded. This is equivalent to you opening the filing cabinet drawer, looking along the dividers until you find the one you want and then preparing to remove the relevant file for reading.

At this point it is worth noting that your files may be too large to fit into the fixed size of one sector. This is no problem. A file always begins in a new sector but may occupy a number of sectors following the first. Each sector can hold up to 256 characters or 'bytes'.

Disc filing system

We mentioned five comparative disadvantages of using a cassette recorder to store information. These may be partly summarised by saying:

You have to control the cassette recorder and keep track of the information on it.

When using a disc this is all done for you by the 'Disc Filing System'. The disc filing system is a machine code program produced by the computer manufacturer. On the BBC computer it is stored in a special kind of memory inside the computer called 'Read Only Memory' or ROM. The program is not lost when you switch the computer off. Once installed, it is always there. All the actions of the disc drive are controlled by the computer using this program. When you prepare new discs by formatting them this is done by the disc filing system. When you **SAVE** one of your BASIC programs the disc filing system does the following:

—Starts the disc drive working.
—Finds a free place on the disc big enough for your program.
—Makes a note of where it put your program so as to be able to find it again.
—Moves the disc drive's read/write head accurately to the start of the first sector in the free space.
—Transfers a copy of your program from the RAM to the disc.
—Stops the disc drive.

All this is done without you having to think about it and is quite a bit quicker than saving a program on to a cassette tape.

When you save a program you have to give it a name. This is true for the disc system as well as the cassette system. However, the disc filing system puts the name to special use. The first two sectors on every disc are reserved for a 'catalogue' when the disc is formatted.

The name of your program, referred to as a 'filename', is written into the catalogue together with the number of the sector on the disc where the information starts. (Note it may continue over several sectors.) When you want the file containing your program back again you simply type `LOAD "filename"`. The filing system checks the catalogue to find out where on the disc to find that file, and then moves the read/write head to that exact place on the disc. The file is then loaded into the computer's memory (RAM) automatically. This illustrates another advantage of a disc drive. The read/write head can be quickly moved to any point on the disc with great accuracy. (Incidentally, the precision engineering needed to accomplish this explains why disc drives cost so much more than cassette recorders.)

Because of this accuracy, a number of other facilities are available besides `loading` and `saving` programs. These include the ability to Copy, Delete, Build and Rename files. Additional facilities let you examine a disc catalogue, restrict access to files or move directly to specific points within a file.

As a final comparison, imagine an automatic filing cabinet where to find something all you have to do is specify the name of a document and paragraph number within it. The filing cabinet drawer opens, the correct divider is selected, the document is located and then presented to you open at the appropriate page. It is not hard to see why microcomputers have become so popular in offices.

Controlling the filing system

The filing system controls the disc drive but in turn we must be able to give instructions to the filing system. Two ways are provided. One is by typing a special command word preceded by the `"*"`. These are all listed in chapter 5 together with details of their functions. Any of these direct commands can be incorporated in a program if required. Chapter 7 of this manual describes the use of a number of BASIC keywords, with special reference to files created on a disc. All these keywords are introduced in the main *User Guide*.

Summary

— A disc system includes a disc drive, some discs, a connection to the computer and a machine code program permanently in the computer called a 'disc filing system'.
— A disc is inserted into a disc drive where it spins round inside its protective jacket.
— The disc drive's read/write head moves in and out along a radius of the disc as it spins around.

— The disc filing system controls the disc drive and the movement of the head.
— Discs are divided into sectors by the filing system and the first two sectors are reserved for a catalogue.
— Programs and other information are stored on the disc and are given a 'filename'.
— By reference to the catalogue the filing system can find any information on a disc associated with a specified filename.
— Files can occupy more than one sector.
— Procedures are provided to locate particular points in files.
— Instructions may be given to the filing system by direct command or from within a program.

2 Getting going

With the power turned off, connect the two cables from the disc drive to the underside of the computer as shown in diagram 1. The plugs are designed so that they will only fit one way. The plug on the power cable is shaped like a rectangle with two adjacent corners cut off. DO NOT force it in the wrong way round. Sometimes the plug on the ribbon cable has a lump on one side which locates into a notch in the socket on the computer. However where this aid is not present you may have to try both possible ways before you get it right. When the drive is connected, turn on the power and press BREAK. The following message, or one very similar should appear on the screen:

```
BBC Computer
Acorn DFS
BASIC
>
```

This indicates that the disc filing system is installed and working O.K. Now press SHIFT and BREAK holding both keys down together. The disc drive motor will start turning for a couple of seconds and the red light on the front of the drive will come on. This shows that the disc is properly connected and working. If nothing happens, check the connections between the disc and computer.

The foregoing assumes that the auto-start option has been set to work when SHIFT is held down with BREAK. See Chapter 10.

Insert the utilities disc into drive 0. (With dual drives, drive 0 is the one directly connected to the computer. See diagram 1, page 12). Press SHIFT and BREAK again. This time the following message will appear on the screen:

Hello, this is the BBC microcomputer. This message was automatically loaded.

The utilities disc has three useful programs:

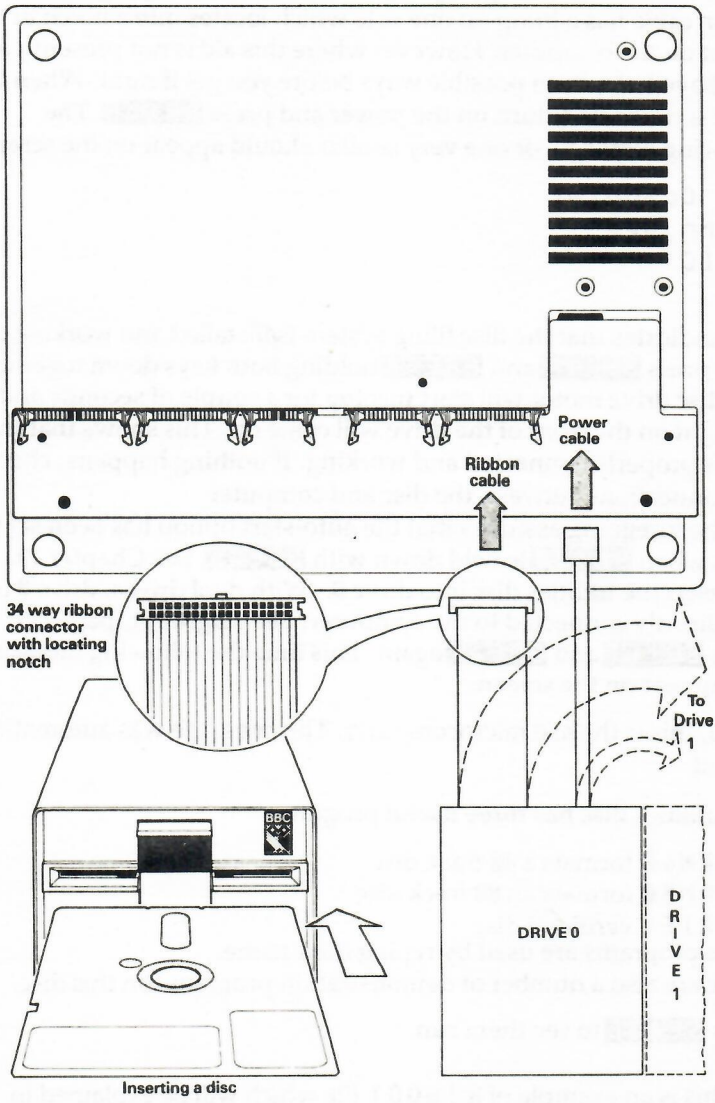
*FORM40 formats a 40 track disc
*FORM80 formats an 80 track disc
*VERIFY verifies a disc
These programs are used by typing their name.
There are also a number of demonstration programs on this disc.

Press SPACE to see them run.

This is an example of a !BOOT file which will be explained in

more detail later. Now press SPACE to continue. This will run the series of demonstration programs supplied on the disc. When the > prompt reappears on the screen you can start entering your programs or filing system commands, but before you do that, read the next two chapters 'Discs' and 'Disc Files'.

Diagram 1 Connecting the disc drive



3 Discs

The BBC Microcomputer uses 5.25" discs for storing information. You may have heard them referred to as 'floppy discs', 'discettes', or 'mini-discs'; we will always refer to them simply as discs. (The American spelling is disk.)

Two types of disc drive are available for the BBC computer, a single unit (100K/bytes) and a dual unit (800K/bytes). Discs used on one type will not work on the other. A disc from a single drive will store about 100 000 characters, equivalent to 50 pages of this book. Discs from a dual drive unit will store about 400 000 characters each. It is possible to use two single disc drives linked together providing space for storing about 200 000 characters, but this is not a standard option.

Handling

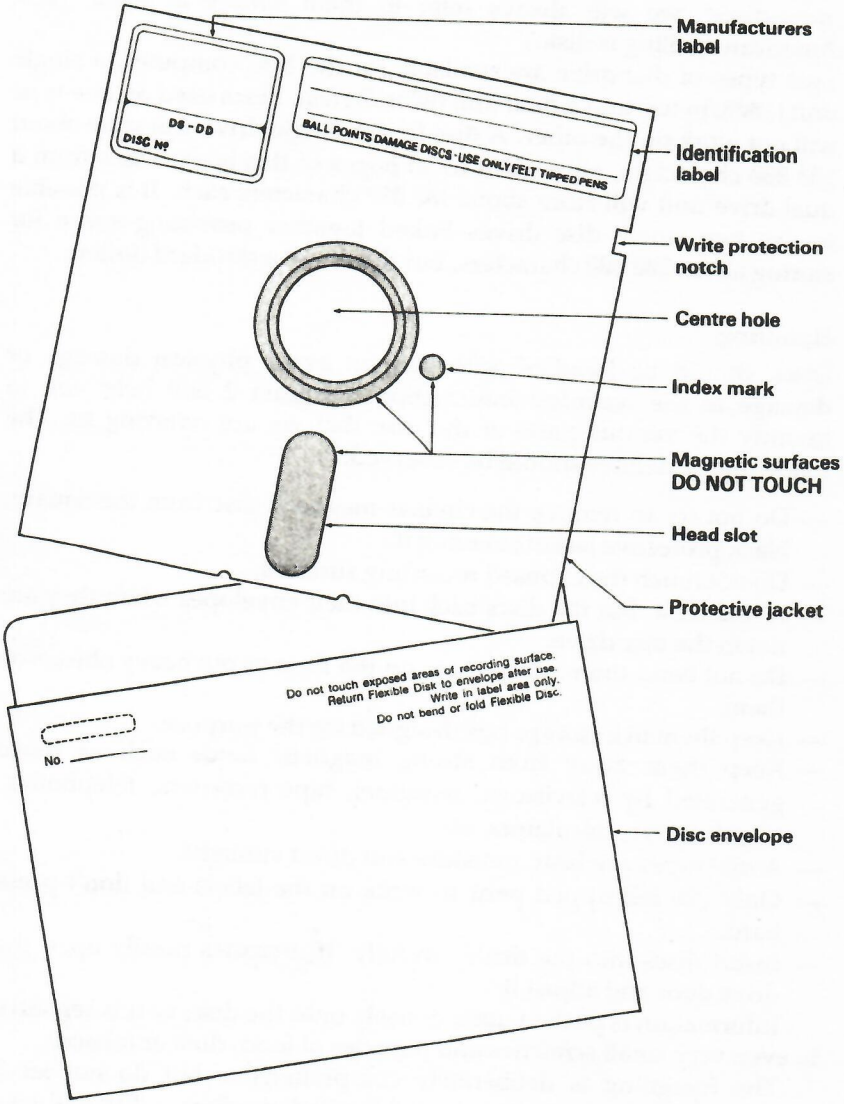
Discs should be handled with care to avoid physical damage or damage to the recorded information. Diagram 2 will help you to identify the various parts of the disc that we are referring to. The following guidelines should be observed:

— Do not try to remove the circular magnetic disc from the square, black protective jacket covering it.
— Do not touch the exposed recording surfaces.
— Avoid dust. Put the discs back into their envelopes when they are not in the disc drive.
— Do not bend them, drop them on the floor or put heavy objects on them.
— Keep them in a storage box designed for the purpose.
— Keep them away from strong magnetic fields such as those generated by televisions, monitors, tape recorders, telephones, transformers, calculators, etc.
— Avoid excessive heat, moisture and direct sunlight.
— Only use felt-tipped pens to write on the labels and don't press hard.
— Insert discs into the drive carefully. If it rotates noisily open the drive door and adjust it.

Information is packed quite densely onto the disc, so it is sensitive to even very small scratches and particles of food, dust or tobacco.

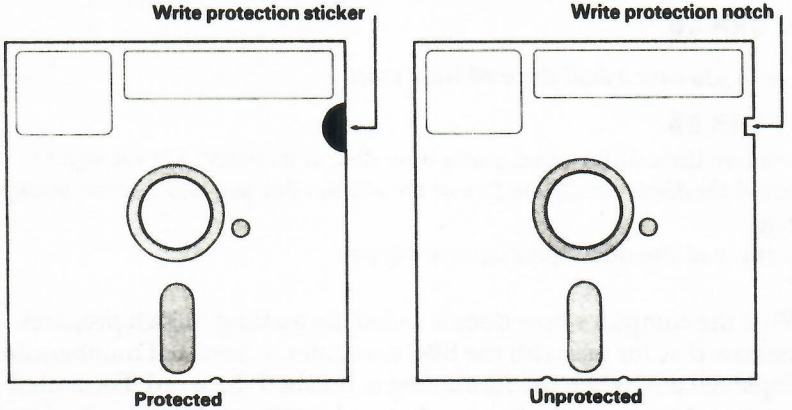
The foregoing is deliberately comprehensive but do not let it frighten you from using the discs. Handled sensibly, a disc will give good service.

Diagram 2: A 5¼" disc



Preventing accidental erasure

You will notice from diagram 2 that there is a small notch in the side of a disc called the 'write-protection' notch. It is used to protect the information on a disc from being overwritten. Every box of discs is supplied with a number of adhesive tabs which can be used to cover the write-protection notch in the disc. The diagram below shows that covering the notch with one of the adhesive tabs will prevent the disc drive from writing to the disc and from deleting anything on it. Reading the existing information on the disc is still allowed.



Another way of protecting important information is to keep several copies of it on different discs. Where computers are used in business industry or other activities which use large volumes of information, a standard routine for this has been evolved. It is often called the 'Grandfather, Father, Son' principle of copying information. Applying this principle to protecting your own information will be beneficial. It works as follows:

Day 1, MASTER copied to GRANDFATHER
Day 2, MASTER copied to FATHER
Day 3, MASTER copied to SON

As you can see, it involves keeping three separate discs, each with a copy of the information from the master disc on it. On day 4 the master would be copied to the grandfather again and so the cycle continues. In business where information on discs changes from day to day this regular routine is important. For personal computing it is not so vital, but you will want to keep several copies of important programs and information which you have worked hard to produce. The filing system provides two facilities which make copying information easy. These are `*BACKUP` and `*COPY` which allow you

to copy a complete disc or specified sections of it. See diagrams 3 and 4 and the appropriate sections of chapter 5 for full details.

We suggest that you make a copy of your utilities disc now!

Proceed as follows

If it has not been done already write-protect the Utilities Disc with a tab, as described. This is very important otherwise you might lose all the information on the disc.

Insert the utilities disc into drive 0 and type

```
*FORM 40
```

or (if you have a dual-drive 80 track unit)

```
*FORM 80
```

Remove the utilities disc, put a new disc in its place. *Do not forget to change the discs over. If you format the utilities disc you will lose everything on it.*

In reply to the question displayed type

```
Y
```

What the computer now does is called 'formatting' which prepares the new disc for use with the BBC computer. A series of numbers are displayed and when the formatting is finished the word 'Formatted' appears. Now remove the new disc and put the utilities disc back again.

If you have a dual-drive

Put the new disc into drive 1 (the other drive) and type

```
*ENABLE
*BACKUP 0 1
```

The computer will now make a complete copy of the utilities disc on the new disc.

If you have a single drive, type

```
*ENABLE
*BACKUP 0 0
```

then follow the instructions on the screen to insert the utilities (Master) disc and the new disc alternately. (See diagram 4).

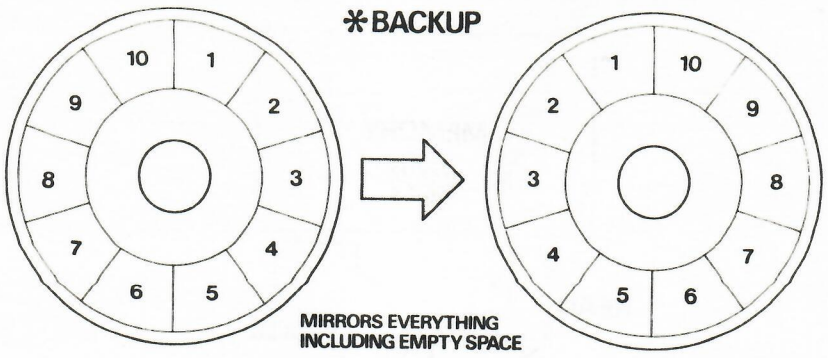
If the message

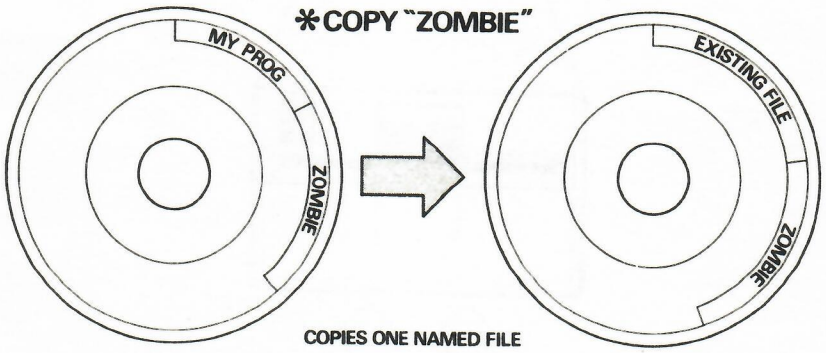
```
Disc write-protected
```

appears it means you had the wrong disc in the drive

Start again from ***ENABLE**.

Diagram 3 Copying





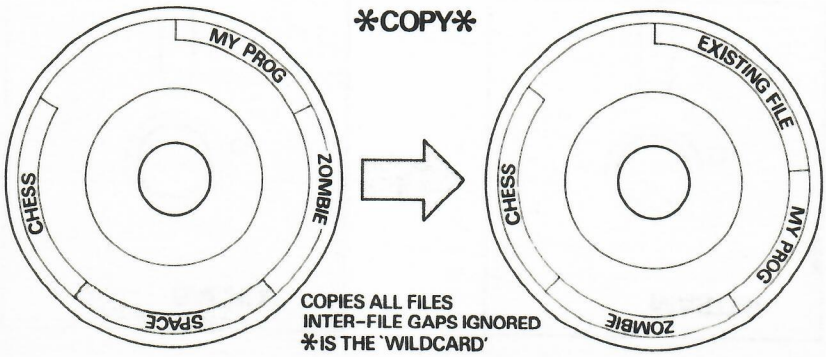
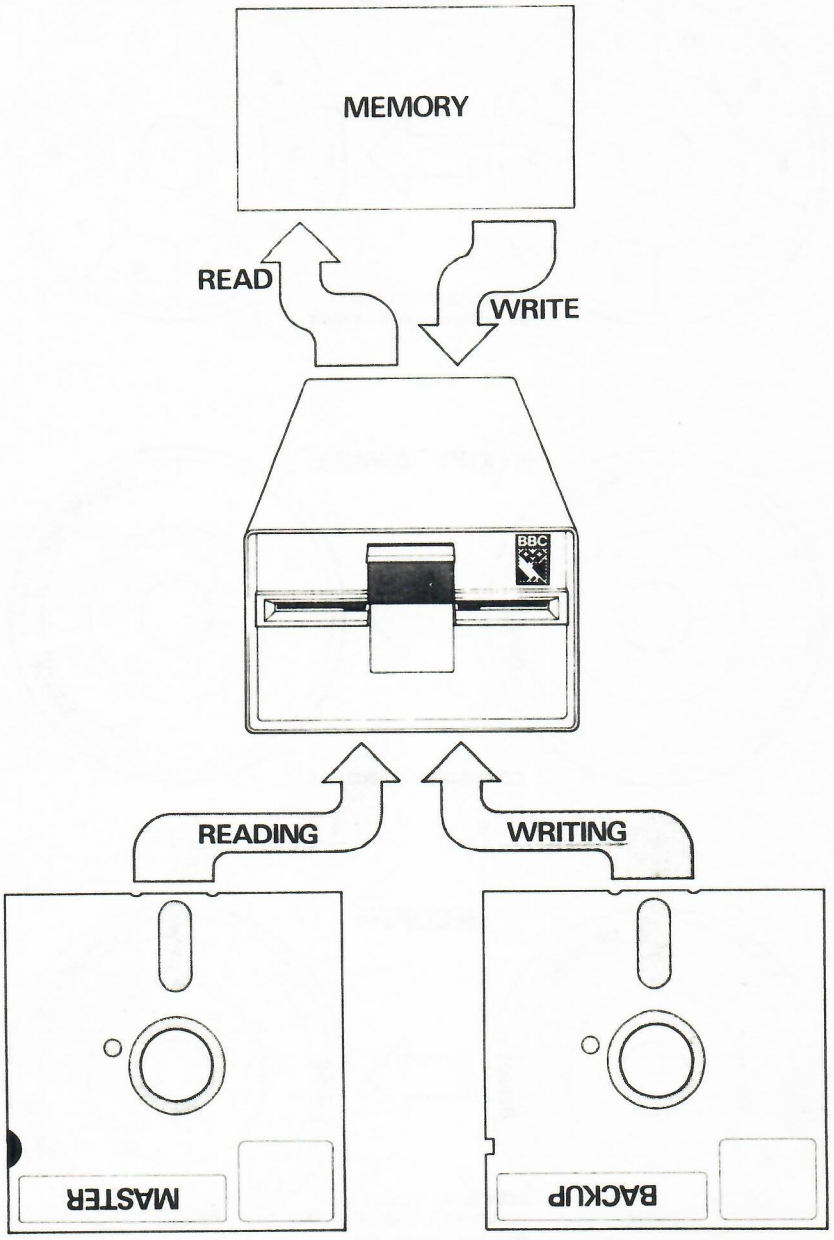


Diagram 4 Single disc drive copying



Tracks, Sectors and Bytes

Information is written on to the disc in concentric circles, called tracks. Each track is divided into ten sectors. Each sector is further divided into 256 bytes. Space on the disc and in the computer's memory is measured in bytes. One byte corresponds to one character. 256 of the bytes in each sector are available for storing your programs and data. From this it follows that a 40 track single-sided, single track density disc of the type used in the single drive unit will hold:

40 tracks x 10 sectors x 256 bytes = 102400 bytes

or characters of information. The dual drive unit uses double-sided, double track density discs. Therefore with 80 tracks on each side, one disc will hold

160 tracks x 10 sectors x 256 bytes = 409600 bytes

or characters of information.

What is formatting?

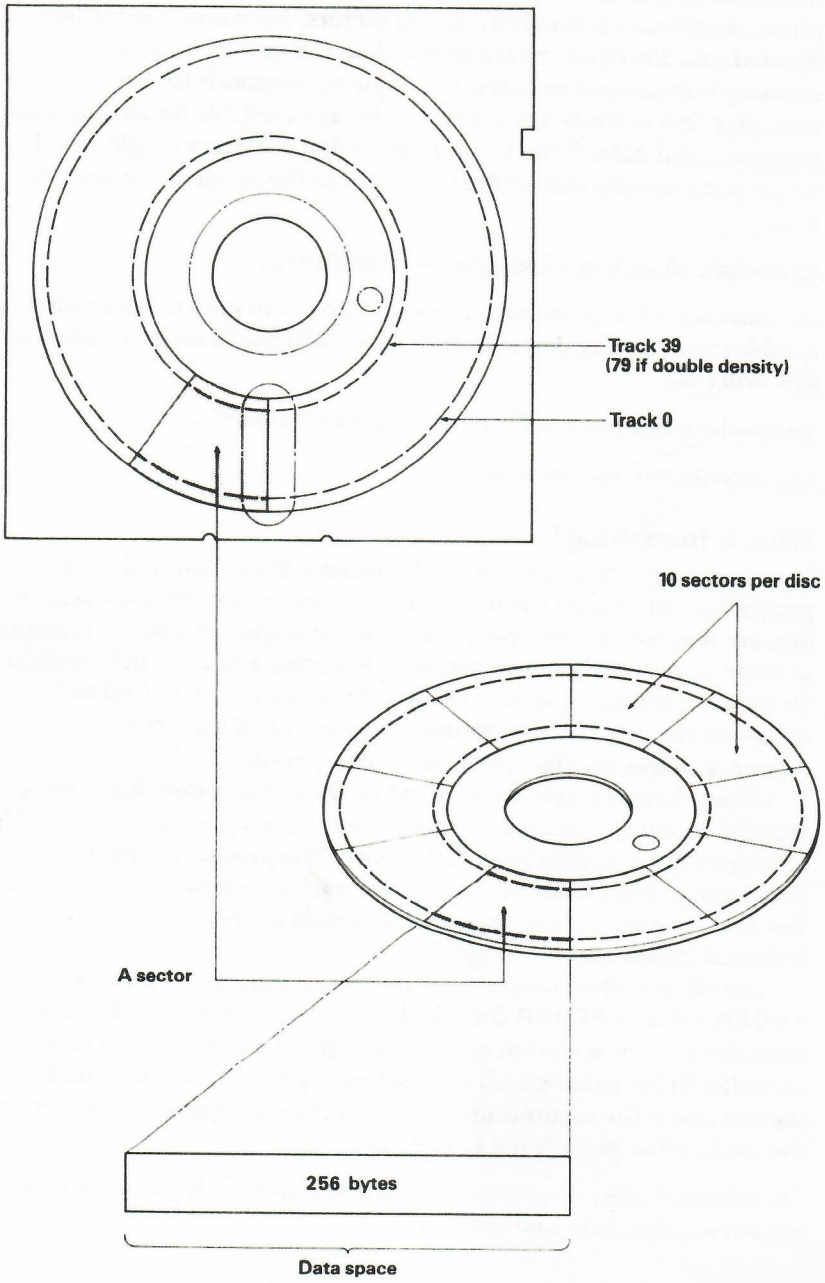
The disc filing system automatically records the location of your programs and data on the disc. The first two sectors on track zero of a disc are reserved for this purpose. The 'catalogue' of a disc is recorded in these sectors. Whenever you wish to access a piece of information on the disc, the filing system reads the catalogue first to find out where on the disc it can be found. The tracks and sectors are the reference marks on disc which make this possible.

Clearly before a disc can be used by the filing system for storing your information it must have these 'reference marks' put onto it. All new discs must be prepared in this way. The process is called 'formatting'. It includes setting up the track and sector format on the disc and creating the catalogue. (Full details are provided in the technical information on page 79).

The filing system utilities disc has two programs on it called `*FORM 40` and `*FORM 80` which perform this task for 40 and 80 track discs. Each sector on each track is given a unique three digit identifier in the catalogue. The first two digits are the track number, the last one is the sector number. The sectors are numbered 0 to 9 and the tracks 00 to 39 or 79 if it is an 80 track disc.

The important thing to remember is that new discs must be formatted before you can use them with your computer.

Diagram 5 Tracks, sectors, bytes



4 Disc files

Probably the first thing you will want to do with the filing system is to record one of your programs onto a disc. You can do this simply by using the **SAVE** command in BASIC and the filing system takes care of the rest. (NB Not to be confused with ***SAVE** described later in this manual). When you have typed the program into the computer the **SAVE** command causes it to be copied on to the disc. When **SAVE'd**, the program must be given a name. This is called the filename and is used to refer to the program if you later want to copy it back from the disc. Each program **SAVE'd** on to the same drive must be given a unique name. The format of the **SAVE** command is

SAVE 'filename'

where 'filename' can be up to 7 characters. Letters and digits are allowed. The characters

 # * . :

have special meanings which are explained later.

The filename is written into the catalogue together with the sector number where the information starts. Next time you refer to the filename the filing system checks the catalogue to see where the information has been placed on the disc, the old file is deleted and replaced by the new one. The filing system ensures that each new file begins with a new sector.

File specifications

The full specification for a file is

: Drive number. Directory. Filename
: ‹drv›. ‹dir›. ‹filename›

e.g:

:1.Z.MYPROG1

Notice the drive number, directory and filename are separated by full-stops. These are needed so that the computer can distinguish the separate parts of the file specification.

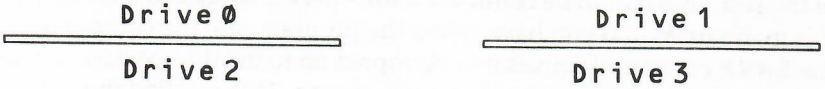
Drive numbers

Drive numbers must be in the range **0** to **3** and preceded by a **:** (colon). The colon in effect tells the computer: 'This is the start of a file specification, the drive number follows.'

The drives are numbered as shown below. Notice that each side of a double-sided disc is given a separate drive number.

Single-drive, single sided

Dual-drive, double sided



The effect of including the drive number in the full specification is that `:1.$.MYPROG 1` is different from `:2.$.MYPROG1` although the file names are the same, they are on different drives.

Directories

The directory is a single character used to divide the catalogue into independent sections. Files of the same name can be created on the same disc with different directories. Although on the same drive,

`:1.$.MYPROG` is a different file to `:1.A.MYPROG`

because the directory is different.

Filenames

The filename can be up to 7 of most of the characters on the keyboard in any combination, except the four previously mentioned. When we need to refer to the complete file specification in future we will use the abbreviation ‹fsp›.

When the filing system is started by pressing BREAK or SHIFT BREAK, the current directory and drive number is always set to *drive Ø and directory* `$`. The drive and directory can therefore be omitted from file specifications. They will be assumed to have these values.

Typing

```
SAVE "MYPROG"
```

will automatically store your program in a file named

`:Ø.$.MYPROG`

assuming you have not changed the current drive and directory. (Chapter 5 'The filing system commands' explains how you can change the current drive and directory with the commands `*DRIVE` and `*DIR`)

Multi-file operations

Another common term used to refer to multi-file operations is 'Wildcard' facilities. Some of the filing system commands can operate on a number of files instead of just one. These are all followed by the abbreviation ‹afsp› instead of ‹fsp›. ‹afsp› stands for 'ambiguous file specification'. `*INFO` is an example of such a command. It provides information about a named file, e.g:

```
*INFO :0.$.MYPROG
```

will display information about the file named `MYPROG` in directory `$` on drive `0`.

However, it is possible that you want information about a number of files. The 'WILDCARD' facilities enable you to specify several files for the command to operate on. The wildcards are provided by the characters `*` and `#` which have special meanings when they appear in the file specification, e.g:

```
*INFO :0.#.MYPROG
```

means; 'Display information about files called `MYPROG` in any directory on drive `0`'.

```
*INFO :0.$.MYPRO#
```

means; Display information about all files on drive `0` in directory `$` with names starting `"MYPRO"` followed by any *single* character.' e.g.:

`MYPROA, MYPROT` and `MYPROG` and so on.

The character `*` means multiple `#`'s to the end of the field, eg

```
*INFO :0.$.M*
```

will display information about any files on drive `0` and directory `$` whose names begin with `M.`

Auto-start facilities

Sometimes it is useful to make a program or a file on one of your discs `*LOAD`, `*RUN` or `*EXEC` automatically when you insert the disc and press BREAK. This can be done using a file named `!BOOT`. `!BOOT` is a special filename recognised by the filing system when you start the computer by pressing SHIFT BREAK. If there is a file of specification

```
:0.$.!BOOT
```

the filing system will do one of four things according to the OPTION set on the disc using `*OPT 4,n` see chapter 5.

Option 0: ignores **!BOOT**
Option 1: ***LOAD's !BOOT** into memory
Option 2: ***RUN's !BOOT** as a machine code program *not a BASIC program*

Option 3: ***EXEC's !BOOT**

See Chapter 5 The filing system commands under the section ***EXEC** for an explanation of *Option 3*. That section also describes how to use this auto-start facility to make the computer run one of your BASIC programs automatically.

The Options can be changed using the ***OPT 4** command. The 'Hello' program on the filing system utilities disc is loaded using a **!BOOT** file.

As well as programs, you may wish to store data on the discs. The filing system provides special facilities for storing and retrieving the data quickly and selectively under the control of your programs.

One of the methods is to use a type of file called a 'Random Access File' – see Chapter 7.

Library directory

The disc file system enables you to specify one drive/directory as the 'Library'. This will always be set to **:0.$** when you start the computer by pressing BREAK. It can be altered using the filing system command ***LIB**, until the next BREAK. All the utility programs should be located in the library. This is because when you type

***** (Utility name)

it is equivalent to typing

***RUN** (Utility name)

where the drive and directory are omitted and will be assumed to be either the *current* drive/directory or the *Library*. The filing system will first search the current drive/directory for the file and then, if it cannot find it there, it searches the Library.

5 The filing system commands

The Disc Filing System is an 8K byte program. BASIC programs are stored on a disc or tape, but the filing system is stored in Read Only Memory (ROM) inside the BBC computer. The filing system controls the reading and writing of information to and from the discs and provides a number of useful facilities for maintaining that information. The following pages describe all the filing system commands. They are words which the filing system program will recognise and act on. They can be typed directly on to the keyboard or embedded within your BASIC program. They are all prefixed with the * character which signals the computer that a filing system command follows. Each command is described under a number of sections with headings as follows:

Command

This is followed by a syntax abbreviation and a few words explaining the derivation of the word.

‹drv›	=	drive
‹fsp›	=	file specification
‹dir›	=	directory
‹afsp›	=	ambiguous file specification

Purpose

A plain English description of what the command does.

Examples

This section gives a few one-line examples of the use of the commands. These examples are only intended to be illustrative.

Description

A description of the command using normal computer jargon.

Association commands

This section lists commands which have similar functions or are normally used in conjunction with this command.

Demonstration program

If appropriate a short program is included to illustrate use of the filing system command in a BASIC program.

Notes

Particular points to watch for or special applications of the command are covered by additional notes if necessary.

Diagrams

Diagrams are used where they make the function of a command clearer.

*ACCESS ‹afsp› (L)

Purpose

To prevent a file from being deleted or overwritten. The command 'locks' or 'unlocks' a file. You cannot delete, overwrite or write to a locked file until you unlock it again. If you load a file which is locked, you will not be able to save it again with the same name. This is because saving a file with the same name as one already on the disc causes the one on the disc to be deleted and replaced with the new file. A locked file cannot be deleted.

Example

```
*ACCESS HELLO L
```

This locks the file `HELLO`

```
*ACCESS HELLO
```

unlocks it again so that it can be deleted or overwritten.

Description

Sets or un-sets file protection on a named file. It prevents a number of other filing system commands from acting on the file.

Notes

Once locked a file will not be affected by the following commands:

```
*SAVE
*DELETE
*WIPE
*RENAME
*DESTROY
```

If you attempt to use any of these commands on a locked file the message

```
File locked
```

is produced.

If you attempt to use `*ACCESS` on a write protected disc the message

```
Disc write protected
```

is produced.

Important

Locking a file does NOT prevent it from being removed from a disc with ***FORM40** or ***FORM80** or from being overwritten with ***BACKUP**.

*BACKUP (source drv) (dest. drv)

Purpose

To read all the information on one disc and write it to another, producing two discs with identical information.

Example

```
*ENABLE
*BACKUP 0 1
```

copies all the information on drive 0 onto drive 1.

Description

Sector by sector copy program.

Associated commands

```
*COPY
*ENABLE
```

Notes

*ENABLE must be typed before the command will work, otherwise the message

```
Not Enabled
```

is displayed

If you give 0 as the source and destination drives, e.g:

```
*BACKUP 0 0
```

the program will alternately ask you to insert the source and destination discs into drive 0. This makes it possible to copy discs even if you only have a single drive. A 40 track disc is copied in 5 sections.

Diagram 4 in chapter 3 illustrates the process.

All information previously on the destination disc is overwritten so be careful not to confuse the source and destination discs. If the source disc is blank the destination disc will end up blank as well.

Warning

The contents of memory may be overwritten by this command. If you have a program or some data in memory that you want to keep, save it before you use the command.

*BUILD ‹fsp›

Purpose

To create a file directly from the keyboard. After typing this command everything else entered will go into the named file. This is useful for creating EXEC files and the !BOOT file described in chapter 3.

Example

```
*BUILD !BOOT
```

will cause everything subsequently typed in to be entered into a file called !BOOT.

Line numbers are displayed on the screen to prompt you to enter your text as follows:

```
>*BUILD !BOOT
00010 FIRST LINE OF TEXT
00020 SECOND LINE
00030 ESC
```

Typing ESC on a line by itself terminates a *BUILD command.

Description

Builds a file from the keyboard.

Associated commands

*EXEC
*LIST
*TYPE

*CAT ‹drv› catalogue

Purpose

The command displays the catalogue of a disc on the screen, showing all the files present on the disc. (drv) is the number of the drive you want displayed. If (drv) is omitted the current drive is assumed.

Example

```
*CAT 0
PROGRAM (nn)
Drive: 0                    Option: 2 (RUN)
Directory: 0.$               Library :0.$

    !BOOT                        HELLO
    SUMS                         TABLE
    TEST                         VECTORS
    ZOMBIE

A. HELLO L                   B.SUMS
```

Note that the heading part of the catalogue shows the drive number, the title of the disc, the currently set auto-start option of the disc (in this case 2 for **RUN**), and the currently selected library and directory. The files are displayed in alphabetical order reading across the two columns. In the example above their are nine files on the disc. **!BOOT** to **ZOMBIE** are in the current directory $. The current directory's files are always listed first. **A. HELLO** is in directory **A**. It is also followed by **L**, meaning, that it is a 'locked' file. (See ***ACCESS** for an explanation.) **B. SUMS** is in directory **B** and is not locked.

Description

Displays a disc catalogue.

Associated commands

***INFO**
***ACCESS**
***TITLE**
***OPT 4, n**
***DIR**
***DRIVE**

Notes

Permitted values of ‹drv› are 0, 1, 2 or 3 nothing.

Other values will cause the message

```
Bad drive
```

to be displayed and you will have to re-enter the command correctly. The top two lines of the catalogue include the disc title, disc option, drive number and current directory.

Important

The Catalogue and hence the disc will hold up to a maximum of 31 files.

*COMPACT ‹drv›

Purpose

Attempting to SAVE a program or file on to a disc may produce the message 'Disc full' if there is no single space available on the disc big enough for the information. It may be that there is enough space, but is is split into several small sections. This command appends all spare space on a disc to the end. When you delete a number of files, the spaces they had occupied will probably be distributed over the disc with current files in between them. *COMPACT moves all current files to the 'start' of the disc leaving the spare space in one continuous block at the end.

Example

```
*COMPACT 1
$.HELLO     1700  801F  0003B  002
$.SUMS      1700  801F  00098  003
:
:
:
```

As 'compacting' proceeds all the current files are displayed in the order in which they occur on the disc.

Description

Moves all available space on a disc into one continuous block following the current files.

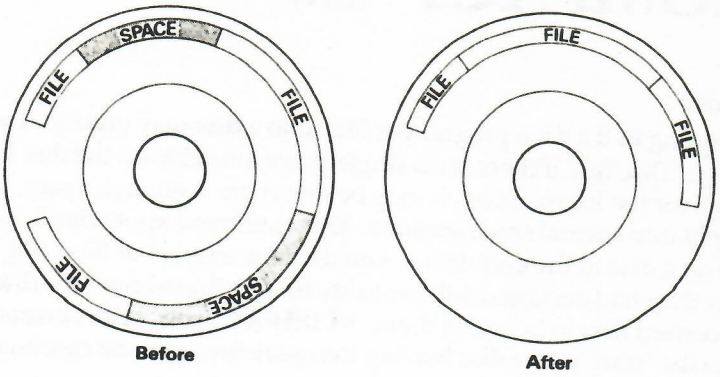
Associated commands

*SAVE and BASIC's SAVE and OPENIN

Notes

This facility will only do anything if there is space between the files. There will only be such space if a file has been deleted from between two others.

Diagram 6 *COMPACT



Warning

This command may overwrite the contents of memory. If you have a program or data in memory that you want to keep, save it before you use this command.

*COPY ‹source drv› ‹dest. drv› ‹afsp›

Purpose
To copy a named file or files from one disc to another.

Example
```
*COPY 0 1 HELLO
```
This copies a file called `HELLO` in the current directory on drive `0` onto drive 1.

Description
File copy program.

Associated commands
`*BACKUP`

Notes
The 'wildcard' facilities may be used to specify a group of files to be copied e.g:

```
*COPY 0 1 #.MY*
```

Copies all files beginning `MY` irrespective of which directory they are in. Information already on the destination disc is not affected.

Diagram
Diagrams 3 and 4 in chapter 3 apply.

Warning
This command may overwrite the contents of memory. If you have a program or data in memory that you want to keep, save it before you use this command.

*DELETE ‹fsp›

Purpose

To remove a single named file from the catalogue of a disc. The space occupied by the file becomes available for other information. Succeeding file names in the catalogue are shuffled up, but not the files themselves. Once a file is deleted you cannot get it back again.

Example

```
*DELETE FRED
```

removes a file called `FRED` from the current directory on the current disc.

Description

Single file deletion.

Associated commands

```
*WIPE
*DESTROY
*COMPACT
```

Notes

If the disc is write-protected the message

```
Disc write protected
```

is produced. If the file is not found in the directory the message

```
File not found
```

is displayed. If the file is locked the message

```
File locked
```

appears.

Once deleted a file cannot be restored.

*DESTROY ‹afsp›

Purpose

To remove specified files from the disc in a single action. This command takes the ambiguous file specification so that groups of files can be deleted. When you use this command a list of the files to be deleted is displayed. A single Yes/No question appears at the end of the list offering you the choice to go ahead and delete all the listed files or not. Use this command with care because its effect is not reversible. It will not attempt to remove locked files. (See *ACCESS).

Example

```
*ENABLE
*DESTROY *.H*
A.HELLO
$.HELLO

Delete (Y/N)?
```

If you type Y in reply to the question all the named files will be deleted. The message

```
Deleted
```

is displayed when the job is done.
Typing anything else cancels the command.

Associated commands

*ENABLE
*WIPE
*DELETE

Notes

Once destroyed files cannot be restored.

*ENABLE must be typed immediately before *DESTROY or it will not work and the message

```
Not enabled
```

is displayed.

*DIR (‹dir›) Set the directory

Purpose

To change the current directory to (‹dir›). The current directory is always set to '$' when you press BREAK. To save files in a different directory in the catalogue you must use this command to change the current directory to the one you want and then save them.

Example

```
*DIRA
```

This sets the current directory to A. You now have access to any files in directory A in the catalogue. Any files now saved using ***SAVE** or **BASIC's SAVE** will be in directory A.

Description

Sets the current directory to the argument supplied.

Notes

Directory can be set to any character except these four exceptions

```
# * . :
```

This command does not alter the directories written in the catalogue. It merely states which directory in the catalogue you have access to by default.

*DRIVE ‹dr› Set current drive

Purpose

Changes the current drive to ‹dr›. Any commands which follow will work on ‹dr› until another drive is specified.

Example

```
*DRIVE 1
```

sets the current drive to 1 and

```
*CAT
```

will produce a catalogue of drive 1

```
*CAT 0
```

will catalogue drive 0 but the current drive is still drive 1 until you change it back to 0 or press BREAK

Description

Sets the current drive.

*DUMP ‹fsp›

Purpose

Produces a hexadecimal listing of a file on the screen.

Example

```
*DUMP SUMS
```

Description

Hexadecimal screen dump.

Associated commands

```
*LIST
*TYPE
```

Notes

It is useful to use this command in page mode so that the file is displayed one page at a time on the screen.

CTRL N selects page mode, CTRL O turns it off.

*ENABLE

Purpose

Some of the filing system commands produce irreversible effects. Two prevent them from being used accidentally it is necessary to type `*ENABLE` before they become operational. These commands are:

```
*BACKUP
*DESTROY
```

Example

```
*BACKUP
```

will not work, the message

```
Not enabled
```

is produced.

```
*ENABLE
*BACKUP
```

will work.

Notes

`*ENABLE` must be typed immediately before the command to be enabled. Any *name command typed in between nullifies the `*ENABLE`.

*EXEC ‹fsp› execute

Purpose

This command reads byte by byte all the information in a named file as if it was being typed on the keyboard. This is useful when you find that you are repeatedly typing the same sequence of commands. Instead you can build an EXEC file consisting of all these commands and type *EXEC ‹fsp› each time you want this sequence of commands. *BUILD ‹fsp› is an associated command used to create an EXEC file.

Example

```
*EXEC HELLO
```

takes the contents of file HELLO and reads it one character at a time as if it was being typed at the keyboard.

Description

Executes the contents of a named file by reading each byte as if it were coming from the keyboard.

Associated commands

*BUILD

Notes

One useful application of the *EXEC command is in association with the auto-start facilities described in chapter 3 and in the section on *OPT4 in this chapter. If you create a !BOOT file containing the BASIC keyword CHAIN followed by the filename of one of your BASIC programs, the effect of pressing SHIFT BREAK will be to automatically load and run the BASIC program.

*HELP ‹keyword›

Purpose

Displays useful information on the screen. In the disc system this consists of a list of the filing system commands or the utilities depending on the ‹keyword› used. The two keywords which produce a response in the disc filing system are **UTILS** and **DFS**.

Example

```
*HELP DFS
DFS 1.00

ACCESS   ‹afsp› (L)
BACKUP   ‹source drv›‹dest›‹drv›
COMPACT  (‹drv›)
COPY     ‹source drv›‹dest drv›‹afsp›
DELETE   ‹fsp›
DESTROY  ‹afsp›
ENABLE
INFO     ‹afsp›
RENAME   ‹old fsp›‹new fsp›
DIR      ‹dir›
DRIVE    ‹drv›
LIB      ‹dir›
TITLE    ‹disc name›
VERIFY   (‹drv›)
WIPE     ‹afsp›

*HELP UTILS
DFS 1.00
BUILD    ‹fsp›
DUMP     ‹fsp›
LIST     ‹fsp›
TYPE     ‹fsp›
```

Notes

***RUN**, ***SPOOL**, ***SAVE**, ***EXEC**, and ***LOAD** are not included in these lists because they are Machine Operating System commands which operate outside the disc filing system. ***HELP** is a Machine Operating System command.

*INFO ‹afsp›

Purpose

Displays information about a file or group of files. It includes details not given by `*CAT` such as the length of the file and its location. It is displayed in the following order across the screen.

Directory	Filename	Access	Load Address	Execution Address	Length in bytes	Start sector

Example

```
*INFO A.HELLO
```

Displays

```
A.          HELLO L     001900 00801F 00003B 003
```

Description

Displays detailed file information.

Associated commands

`*CAT`

Notes

If the file is not found on the specified (or assumed) drive and directory the message

```
File not found
```

is produced. The command must be re-entered using the correct ‹afsp›.

The wildcard facilities # and * may be used if you want information about a group of files.

*LIB :(‹drv›). ‹dir› Selects the library.

Purpose

Sets the library to the specified drive and directory.

Example

```
*LIB :1.A
```

sets the library to drive 1 directory A. After this typing

*‹filename›

will search directory A on drive 1 for the named file and if it is found the file will be loaded and executed just as if you had typed.

```
*RUN :1.A. <filename>
```

Description

Sets the drive/directory containing the library.

Associated commands

*RUN

Notes

The library can contain files which are utility programs, designed to act on other files e.g. Sorts, Edits and Merges are all common utility programs. It is then possible to say:

```
*SORT FRED
```

where SORT is the name of the file in the library and FRED is the name of another file in the current drive and directory. This makes use of the fact that any text after the ‹fsp› is stored in memory and is available to your machine code program for interpretation. A pointer to the start address of this text is available to your program via a call to OSARGS with Y=0, A=1 and X=the address of the 4 byte block in page 0 where the text is stored. To read the text stored at this location you must use a call to OSWORD with A=5.

OSWORD call with A=5.

Read I/O processor memory. This call enables any program to read a byte in the I/O processor no matter in which processor the program is executing.

On entry X and Y point to a block of memory as follows

XY	LSB	of address to be read
XY+1		
XY+2		
XY+3	MSB	of address to be read

On exit the 8 bit byte will be stored in XY+4.

As this routine reads one byte at a time you may need to use repeated calls to it to recover all the text following the ‹fsp›.

Chapter 8 provides more information about using the disc system from assembler programs.

*LIST ‹fsp›

Purpose

Displays a text file on the screen with line numbers.

Example

```
*LIST DATA
```

displays the contents of the file called **DATA** on the screen, line by line with each line numbered.

Description

ASCII list with line numbers.

Associated commands

*TYPE
*DUMP

Notes

BASIC is tokenised so listing a BASIC program file will display nonsense. (See the User Guide). An **ASCII** text file of a BASIC program can be obtained using the ***SPOOL** command.

Files written with BASIC keyword **PRINT#** can also be listed with this command.

In page mode the listing will stop after displaying each screen full until you press either **SHIFT** key to make it continue. **CTRL N** turns page mode on, **CTRL O** turns it off.

*LOAD ‹fsp› ‹address›

Purpose

Reads a named file from the disc into memory in the computer starting at either a specified start address or the file's own load address.

Example

```
*LOAD HELLO
```

Reads the file HELLO into memory starting at location 1900 (hex), which is the load address of the file when it was saved.

(See example in *INFO)

```
*LOAD HELLO 3200
```

Reads the file HELLO into memory starting at location 3200 (hex). Other examples are

```
LOAD "HELLO"
LOAD "HELLO" 3200
```

Description

Loads a file into memory.

Associated commands

*SAVE
*RUN

Notes

All the above are valid commands. The quotation marks are optional; but either a pair, or none should be present. The named file must be in the current directory on the current disc. If the file is not found the message

```
File not found
```

is produced.

*OPT 1 (n)

Purpose

This command enables or disables a message system which displays a file's information (the same as *INFO). Every time a file on the disc is accessed the information is displayed. (n) can be anything from 1 to 99 to enable the feature. (n) = 0 disables it.

Example

*OPT 1 1 or *OPT 1, 1

enables the messages;

*OPT 1 0 or *OPT 1, 0

disables the messages.

Description

Message system to display file information at every access.

Associated commands

*INFO

Notes

A space or a comma between *OPT 1 and its argument (n) is essential.

*OPT 4 (n)

Purpose

Changes the auto-start option of the disc in the currently selected drive. There are four options to choose from 0, 1, 2 or 3. Each option initiates a different action when you press SHIFT and BREAK on the computer. The computer will either ignore or automatically LOAD, RUN or EXEC a file callled !BOOT which must be in the directory $ on drive 0.

Example

```
*OPT 4 0 does nothing
*OPT 4 1 will *LOAD the file !BOOT
*OPT 4 2 will *RUN the file !BOOT
*OPT 4 3 will *EXEC the file !BOOT
```

Description

Changes the start-up option of a disc.

Notes

It is essential to include a space between the command and (n). *OPT40 would produce the message.

```
Bad option
```

If the disc is write-protected the error message

```
Disc write-protected
```

is produced in response to the *OPT 4 command.

If the option 0 is set the !BOOT file need not be there. With any other option the message

```
File not found
```

is produced if !BOOT is not found in directory $ on drive 0.

Important

Do not confuse *OPT 4 with BASIC keyword OPT or *OPT 1. They are completely different. Refer also to Chapter 11 where it describes how to swap the effects of BREAK and SHIFT-BREAK.

The utilities disc is set to option 2 when you receive it so when you press SHIFT-BREAK the 'HELLO' program, saved as file !BOOT, is *RUN automatically.

*RENAME ‹old fsp› ‹new fsp›

Purpose

Changes the file name and moves it to another directory if required.

Example

```
*RENAME SUMS B.MATHS
```

Assuming that the current directory is **$**, the file **$.SUMS** becomes **B.MATHS**.

Description

Renames a file.

Notes

```
*RENAME :0.$.SUMS :1.B.MATHS
```

This is not allowed. The file cannot be moved from drive **0** to drive **1** using ***RENAME**. Only the directory and filename can be changed.

If the file does not exist the message

```
File not found
```

is displayed. If the first file is locked

```
File locked
```

is displayed. If the disc is write-protected

```
Disc write-protected
```

is displayed. If the ‹new fsp› has already been used the message

```
File exists
```

is displayed.

*RUN ‹fsp› (parameters to utility)

Purpose

This command is used to run machine code programs. It loads a file into memory and then jumps to the execution address of that file.

Example

```
*RUN PROG
```

will cause a machine code program in the file called **PROG** to be loaded and executed starting at the execution address of the file.

Description

Runs a machine code program.

Associated commands.

***SAVE**
***LIB** (for an explanation of 'parameters to utility')

Notes

This command will not run a BASIC program.

Typing*****‹fsp› is accepted as being ***RUN** ‹fsp›.

Typing ***** <filename> results in the file being loaded and executed if it is found in the currently selected drive/directory or the library.

*SAVE ‹filename› ‹start address› ‹finish address› (‹execute addr.›) (‹reload addr.›)

Purpose

It is important not to confuse this with the BASIC keyword **SAVE**, they are quite different. This command takes a copy of a specified section of the computer's memory and writes it on to the disc in the current drive/directory. It is put into a file of the given name. You will mostly use this command to record your machine code programs.

Example

```
*SAVE "PROG" SSSS FFFF EEEE RRRR
*SAVE "PROG" SSSS LLLL EEEE
```

SSSS= Start address of memory to be saved
FFFF= Finish address
EEEE= Execution address (see below)
RRRR= Reload address
LLLL= length of information

Notes

RRRR and **EEEE** may be omitted in which case the reload address and the execution address are assumed to be the same as the start address.

If the disc is write-protected the message

```
Disc write-protected
```

is produced. If there are already 31 files on the disc the message

```
Directory full
```

is produced. If the specified filename already exists and is locked the message

```
File locked
```

is produced. If the file already exists but is unlocked it is deleted. Then starting in sector 2 track 0 a gap large enough to hold the new information is searched for. If none is found the message

```
Disc full
```

is produced.

If enough space is available, the information is written on to the disc and the filename is entered on to the catalogue in the current directory.

*SPOOL ‹fsp›

Purpose

Prepares a file of the specified name on the disc to receive all the information subsequently displayed on the screen. This is a very useful command particularly for producing a text file of one of your BASIC programs. (See notes below)

Example

You can obtain a text file of one of your BASIC programs as follows:

```
LOAD "MYPROG"
```

Loads a program from disc into memory.

```
*SPOOL TEXT
```

Opens a file called `TEXT` on the disc ready to receive information from the screen.

```
LIST
```

Causes the BASIC program to be displayed on the screen and also written onto the file called `TEXT`.

```
*SPOOL
```

Turn off the 'spooling' and closes the file called `TEXT`.

Description

Spools subsequent output to the screen to a named file opened for the purpose. Closes the file when spooling is terminated.

Associated commands

```
*BUILD
*EXEC
*LIST
*TYPE
```

Notes

BASIC on the BBC microcomputer is 'tokenised'. This means that the lines which you type in your program are abbreviated inside the computer's memory and on the disc. A program file will contain these abbreviated 'tokens' rather than your original program text.

Displaying the file using *LIST will therefore produce strange results. The example above shows you how to create a file containing your original program text. If you display that file using *LIST your program will appear just as you typed it in.

*TITLE ‹disc name›

Purpose

Changes the title of the disc in the current drive to the first twelve characters after the command. It fills in with 'nulls' if there are less than twelve characters. Any characters are allowed.

Example

```
*TITLE "MY DISC"
```

This sets the title to `"MY DISC"` with five 'nulls' added on the end.

```
*TITLE "A DIFFERENT TITLE"
```

This changes the title to `A DIFFERENT`. Anything after the first 12 characters is ignored. The quotation marks are only required if the title includes spaces.

Notes

If the disc is write-protected the message

```
Disc write-protected
```

appears when you try to use this command.

*TYPE ‹fsp›

Purpose
Displays a text file on the screen without line numbers.

Example
```
*TYPE HELLO
```

Description
Screen list of a named file.

Associated commands
```
*LIST
*DUMP
```

Notes
BASIC programs are not stored on disc as text files when you **SAVE** them so this command will display nonsense.

Page mode is selected with **CTRL N** and turned off by **CTRL O**

*WIPE ‹afsp›

Purpose

Removes specified files from the catalogue and rearranges the catalogue. Asks for confirmation that each file conforming to the specification is to be deleted.

Example

```
*WIPE *.SU*
```

is a request to delete all files on the current drive beginning with the letters SU. As each file is found the filename is displayed like this:

```
A.SUM
```

At this point *only* type "Y" if you want to delete the file. Typing anything else leaves the file intact.

Description

Delete with ‹afsp› and confirmation per file.

Associated commands

*DESTROY
*DELETE

Notes

Once deleted using *WIPE, a file cannot be restored. Locked files are not removed. (See *ACCESS).

6 The filing system utilities

As explained in chapter 5 the filing system commands are, in fact, programs stored in ROM (read only memory) inside the BBC microcomputer.

The utilities are similar programs but they are stored on the utilities disc. They are used in the same way as the commands by typing

*(Utility name)

The utilities disc must be in the disc unit at the time. The utility must either be in the current directory on the current drive or in the library (see command *LIB).

There are two 'formatting' utilities supplied; one for 40 track discs; the other for 80 track discs. On the utilities disc these are normally in drive 0, directory $, which are the default values on start-up for both the Library and the Current drive/directory. (See command *DRIVE and *DIR). The third utility is *VERIFY.

The following pages describe the utilities. You can add utilities of your own by saving machine code programs into the library.

*FORM40 (‹drv›) Format a 40 track disc.

Purpose

The command prepares new discs for using with the filing system on the BBC microcomputer. It marks areas of disc where information will be stored and sets up a catalogue. The catalogue is empty at first but when you store programs and data on the disc the catalogue records their positions on the disc. They can then be retrieved quickly by reference to the catalogue. While formatting the information put on to the disc is verified automatically.

Example

1 To format a new disc insert the utilities disc into the disc drive and type

```
*FORM40
```

The computer asks

Do you really want to format drive 0?

Remove the utilities disc. Insert the disc to be formatted and then answer

```
Y
```

The formatting starts immediately and the message

```
Formatting drive (n)
```

is displayed. As each track is formatted and verified the track number is displayed as follows:

```
00 01 02 03 04 05 06 07 08 09
0A 0B 0C 0D 0E 0F 10 11 12 13
14 15 16 17 18 19 1A 1B 1C 1D
1E 1F 20 21 22 23 24 25 26 27
disc formatted
```

Above is the response if the formatting was successful. If not, the formatting will stop and either the message

```
Verify error
```

OR

```
Format error
```

is displayed

After successful formatting the message

```
Repeat format (Y/N)
```

is displayed. You can format another disc straight away.

Description

Initialises discs with track and sector format. Clears the catalogue and verifies the sectoring.

Associated commands

```
*FORM80
```

Notes

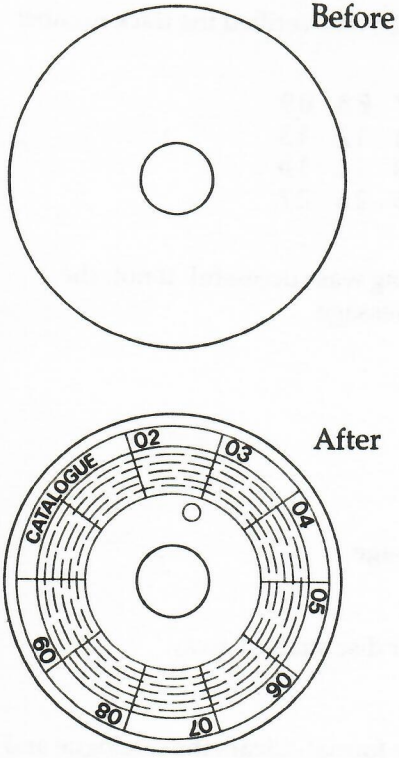
`*FORM80` is the same except that it formats the `80` track discs used in the dual drive system.

If you find that verification or formatting fails persistently it could be that either the discs you have are poor quality or that the disc drive needs servicing.

The drive number may be omitted from the command. The current drive will be assumed. If you have a dual drive system you

can format a disc in the second drive while the utilities disc remains in the first drive.

Diagram 6 Formatting



*VERIFY (‹drv›)

Purpose

Checks each sector of a disc for legibility. It is done automatically when you use the *FORM40 and FORM80 commands.

Example

```
*VERIFY 1
```

verifies drive 1.

Description

Sector verification program.

Associated commands

*FORM40
*FORM80

7 Random access files

One of the major advantages of a disc over a cassette tape is that the read-write head of the disc can be moved to a specific place on the disc quickly and accurately. Imagine you have a data file on cassette tape consisting of 'Names' and 'Telephone numbers'. To find a specific telephone number the file must be loaded and read from the beginning until the required record is found. If the file is long this will take some time. On the other hand, the Disc Filing System allows you to move to the required record and just read that one. Clearly this is much quicker.

To make this possible the Disc Filing System provides a pointer. The pointer points to a particular character in the file. It is the next character on the file to be read or written. In BASIC the pointer is controlled by the keyword **PTR#**. The other keywords in BASIC which are used in connection with disc files are **EXT#** and **EOF#**. **EXT#** tells you how long a file is, **EOF#** returns a value of **TRUE (-1)** if the end of file has been reached and **FALSE (0)** if not. All the BASIC keywords used to manipulate disc files are explained in the *User Guide*. They are:

```
OPENOUT
OPENIN
PTR#
EXT#
INPUT#
PRINT#
BGET#
BPUT#
EOF#
```

To prepare a file to receive data the **OPENOUT** keyword is used. In the *User Guide* the following example is given:

```
330 X = OPENOUT ("cinemas")
```

The effect of this line in a BASIC program is as follows:

1 If a file called 'cinemas' exists it is deleted.
2 A file called 'cinemas' is entered on to the disc catalogue of the currently selected drive, in the current directory.
3 The filing system reserves 64 sectors (or the length of the previous file called 'cinemas' if there was one) on the disc for the exclusive

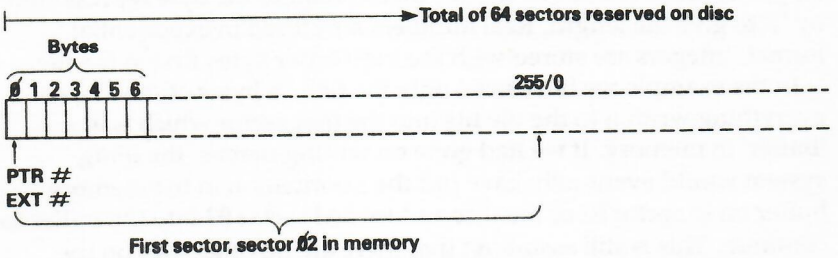
use of the file 'cinemas'. If 64 sectors are not available, the file is not created and an error is produced.

4 Evaluating **PTR#** and **EXT#** at this point will reveal that they are both set to zero.

5 The filing system will have loaded into memory the first sector, 256 bytes of the file. This area of memory is specially reserved by the filing system for this purpose and is referred to as the 'Buffer'.

Notice that the first action of the keyword **OPENOUT** is to delete any existing file of the specified name.

If there were no files on the disc previously, the effect can be illustrated as follows:

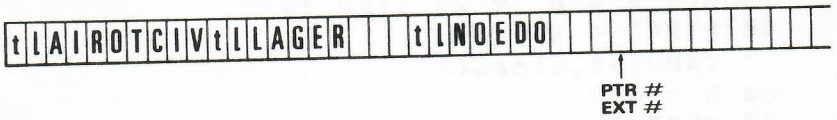


Nothing has been written on the file, so the value of **EXT#** (extent) is zero.

We can now use the BASIC keyword **PRINT#** to write three cinema names into these slots of 10 characters each, as follows:

```
340 A = PTR#X
350 PRINT# X, "VICTORIA"
360 PTR#X = A+10
370 PRINT# X, "REGAL"
380 PTR# X = A+20
390 PRINT# X, "ODEON"
400 PTR# X = A+30
```

In practice you can do it much more elegantly than shown above. Nevertheless the result immediately after line 400 is:



Notice that the cinema names (in this illustration, VICTORIA) are in the file backwards. They are preceded by two bytes, represented in the diagram by 't' and 'l'. 't' specifies the type of data which follows. In

this case the type is 'string' so the first byte will contain &00 in hex, as indicated in the table below.

't' = &00 = String type, followed by '1', followed by the string.

't' = &40 = Integer type, followed by four bytes containing the integer.

't' = & FF= Real type, followed by five bytes containing the real number.

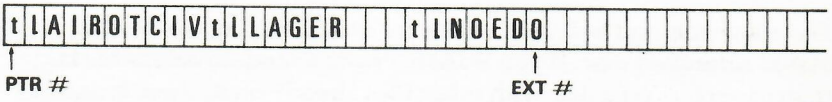
In our example the second byte, represented by '1', gives the length of the string in hex. The integer and real number types are of fixed length as indicated above so they do not require the byte represented by '1' to give the length. Real numbers are stored in exponential format, integers are stored with the high order bytes first in the file.

In the example we have used only the first 26 bytes of the file, so everything written to the file fits into the first sector which is in a 'buffer' in memory. If we had gone on writing names, the filing system would eventually have put the information in the memory buffer on to sector 02 of the disc and loaded sector 03 into the buffer to continue. This is still assuming that there are no other files on the disc, otherwise different sectors would be used. Remember that sectors 00 and 01 are reserved by the disc filing system for the disc catalogue. Clearly then, at the end of a sequence of writing actions, we are left with a buffer in memory which may be partly filled with information. We must make sure that this information is written to the disc. This is done with the **CLOSE#** keyword in BASIC. This empties the buffer and frees the channel on which we opened the file (X in the example).

We can now read the information back from the disc if we want to. **OPENIN** is the BASIC keyword used to do this, e.g:

```
5  DIM cine$(3)
10 X = OPENIN ("cinemas")
20 B = 1
30 FOR A = 0 TO 20 STEP 10
40 PTR#X = A
50 INPUT#X,cine$(B)
60 B = B+1
70 NEXT A
```

Line 10 of the example opens the file 'cinemas' loads the first sector into the buffer and sets **PTR#** to zero and **EXT#** to the length of the file.



Lines 30 to 50 of the example read each cinema name into an element of the array **cine$**, advancing the pointer to the start of the next name after reading each one. Now you can see why we stored each name in its own '10 byte record'. This makes it much easier to write a program to find the names again.

The important principle about using Random Access Files is that you must keep track of where each item of information is written. You can then set **PTR#** to point to it again when you want to read or change it. The examples illustrate the basis of a very simple technique. There are a number of others which you can devise.

Note 1

As shown earlier is this discussion, **OPENOUT** reserves 64 sectors for a file. Other files opened may reserve sectors which immediately follow, e.g.

```
X = OPENOUT ("cinemas")
Y = OPENOUT ("clubs")
```

The statements reserve 128 sectors consecutively if the disc was otherwise empty.

It may be that you require more than 64 sectors for the first file 'cinemas'. If so, you will need to write 'dummy' records to the file to extend it to the required length before you open the second file. e.g:

```
10 X = OPENOUT ("cinemas")
20 FOR A = 1 TO 200
30 PRINT#X, "DUMMY NAME FIELD"
40 PRINT#X, "DUMMY ADDRESS LINE ONE"
50 PRINT#X, "DUMMY ADDRESS LINE TWO"
60 PRINT#X, "ADDRESS LINE THREE"
70 PRINT#X, "POST CODE123"
80 NEXT A
```

This program creates a file 79 sectors long with the dummy name and address written every 100 bytes.

By writing beyond the reserved area in this way you can effectively reserve as many sectors as you like. You can then open other files in the remaining space on the disc. **EXT#** will give the position of the '3' after the last dummy address on the file (20000).

The above method will only work consistently if you start with a blank, formatted disc. If you want to create a random access file larger than 64 sectors on a disc with other files already on it, there is another method.

First save the file with the name you want and with the number of bytes required. Use the address parameters of the ***SAVE** command to specify the number of bytes, e.g:

```
*SAVE "DATA" 00000 08000
```

will create a file of 128 sectors (32K) called **DATA**. You can then open the file later in your program. The file will contain miscellaneous data which you can overwrite with the information you actually want. This second method causes the filing system to search the disc for a free space large enough to hold the file. Existing files will be skipped over if they would otherwise overlap with the new file

Note 2

Up to 5 files may be open at any one time. This is because the space reserved for each file in the computer's memory to hold the information about extent, pointer etc. is limited. In certain versions of the disc filing system, the commands ***LOAD**, ***SAVE**, ***EXEC**, ***SPOOL**, ***BUILD**, ***LIST** and ***DUMP** each use the space occupied by the information relating to one open file while they are active.

8 Using the filing system in assembler

Section 43 of the *new User Guide* is essential reading for anyone wanting to write assembler programs on the BBC microcomputer. Most of the necessary information for using the filing system in assembler is presented there. In this chapter the main points are summarised and a particular use of **OSWORD** is described in detail.

General Principles

There are a number of routines available to handle disc I/O. All the routines must be called with a JSR and the decimal flag clear. It is important that you use these routines. They are called in address range &FF00 to &FFFF. They then call an internal (ROM resident) routine whose address is stored in RAM between &0200 and &02FF. The address here will vary according to the filing system in use. For example, the routine **OSFIND** to open or close a file is entered at &FFCE. It is indirected via &021C. &021C and &021D contain the address of the executable routine in the disc file system ROM. You can intercept the call by changing the addresses in these RAM locations.

Using the available routines you can perform all necessary functions relating to disc files. The relevant routines together with their entry points are as follows:

OSFIND	&FFCE	FINDV	&021C	Open or close a file
OSARGS	&FFDA	ARGSV	&0214	Load or save data about a file
OSFILE	&FFDD	FILEV	&0212	Load or save a complete file
OSBGET	&FFD7	BGETV	&0216	Read a single byte to A from the file
OSBPUT	&FFD4	BPUTV	&0218	Write a single byte from A to the file
OSGBPB	&FFD1	GBPBV	&021A	Load or save a number of bytes
OSWORD	&FFF1	WORDV	&020C	With A=&7F and a parameter block, loads or saves a sector.

OSFIND

Opens a file for writing or reading and writing. The routine is entered at &FFCE and indirects via &21C. The value in A determines the type of operation.

A=0 causes a file or files to be closed
A=&40 causes a file to be open for input (reading)

A=&80 causes a file to be opened for output (writing)
A=&C0 causes a file to be opened for input and output (random access)

If A=80 or &C0 then Y (high byte) and X (low byte) must contain the address of a location in memory which contains the file name terminated with `Carriage return` (&0D). On exit Y will contain the channel number allocated to the file for all future operations. If Y=0 then the operating system was unable to open the file.

If A=0 then a file, or all files, will be closed depending on the value of Y. Y=0 will close all files, otherwise the file whose channel number is given in Y will be closed.

On exit C, N, V and Z are undefined and D=0. The interrupt state is preserved, however interrupts may be enabled during the operation.

OSARGS

This routine enables a file's attributes to be read from file or written to file. The routine is entered at &FFDA and indirects via &214. On entry X must point to your locations in zero page and Y contains the channel number.

If Y is non-zero then A will determine the function to be carried out on the file whose channel number is in Y.

A=1 write sequential pointer

A=0 read sequential pointer.

A=2 read length

A=&FF 'ensure' that this file is up to date on the media

If Y is zero then the contents of A will determine the function to be carried out.

A=0 will return, in A, the type of file system in use. The value of A on exit has the following significance

0 no file system
1 1200 baud cassette file system
2 300 baud cassette file system
3 ROM pack file system
4 Disc file system
5 Econet file system
6 Teletext/Prestel Telesoftware file system

A=1 return address of the rest of the command line in the zero page locations
A=&FF 'ensure' that all open files are up to date on the media

On exit

X and Y are preserved, C,N,V and Z are undefined and D=Ø. The interrupt state is preserved but interrupts may be enabled during the operation.

OSFILE

This routine, by itself, allows a whole file to be loaded or saved. The routine is entered at &FFDD and indirects via &212.

On entry

A indicates the function to be performed. X and Y point to an 18 byte control block anywhere in memory. X contains the low byte of the control block address and Y the high byte. The control block is structured as follows from the base address given by X and Y.

OSFILE control block

ØØ Ø1	Address of file name, which must be terminated by &ØD	LSB MSB
Ø2 Ø3 Ø4 Ø5	Load address of file	LSB MSB
Ø6 Ø7 Ø8 Ø9	Execution address of file.	LSB MSB
ØA ØB ØC ØD	Start address of data for write operations, or length of file for read operations	LSB MSB
ØE ØF 1Ø 11	End address of data, that is byte after last byte to be written or file attributes.	LSB MSB

The table over page indicates the function performed by OSFILE for each value of A.

A=0 Save a section of memory as a named file. The files catalogue information is also written
A=1 Write the catalogue information for the named file
A=2 Write the load address (only) for the named file
A=3 Write the execution address (only) for the named file
A=4 Write the attributes (only) for the named file
A=5 Read the named files catalogue information. Place the file type in A.
A=6 Delete the named file
A=&FF Load the named file

When loading a file the byte at XY+6 (the LSB of the execution address), determines where the file will be loaded in memory. If it is zero then the file will be loaded to the address given in the control block. If non-zero then the file will be loaded to the address stored with the file when it was created.

The file attributes are stored in four bytes. The least significant 8 bits have the following meanings:

Bit	Meaning
0	not readable by you
1	not writable by you
2	not executable by you
3	not deletable by you
4	not readable by others
5	not writable by others
6	not executable by others
7	not deletable by others

File names are as follows:

0 nothing found
1 file found
2 directory found

A BRK will occur in the event of an error and this can be trapped if required.
On exit X and Y are preserved, C, N, V and Z are undefined and D=0. The interrupt state is preserved but interrupts may be enabled during the operation.

Read/write one byte

OSBGET call address &OFFD7 to get a byte
OSBPUT call address &OFFD4 to put a byte

Y contains the channel number on which the file was opened using OSFIND.
X is not used, but preserved.
A contains the byte to be put or receives the byte which is read.

The position in the file where the action of the GET or PUT takes place is determined by the position of the pointer as set by OSARGS.

On Exit

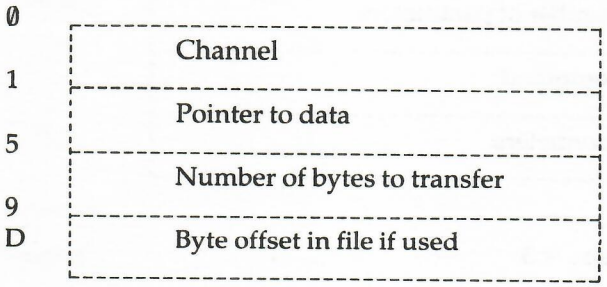
C clear implies a successfully completed transfer.
C set implies end of file reached before completion of transfer.

Read/write a group of bytes

OSGBPB Call address &ØFFD1.
This routine will read or write a byte (or group of bytes) to or from a specified open file. The option to read or write is determined by the value of A. The length of the data and its location are specified in a control block in memory.

On entry X (lo-byte) and Y (hi-byte) point to the instruction block:

Offset



A determines the type of operation:

A = &Ø1 Put bytes using byte offset
A = &Ø2 Put bytes ignoring byte offset
A = &Ø3 Get bytes using byte offset
A = &Ø4 Get bytes ignoring byte offset

This method is particularly useful in the environment of the ECONET® file system where the 'packaging overhead' for transferring small amounts of data is proportionately high.

ECONET is a trademark of Acorn Computers Ltd.

On Exit

C clear implies a successfully completed transfer.
C set implies end of file reached before completion of transfer. The number of bytes and byte offset (if used) are modified to show how much data has been transferred (usually as much as was asked for) and the new pointer value is the old pointer plus the amount transferred.

Read/write a sector

OSWORD with A=&7F
Call address at &0FFF1.
A=&F7 indicates that a general read/write operation is required.

On entry X (lo-yte) and Y (hi-byte) point to the instruction block:

Offset	
0	Drive number
1–4	Start address in memory of source or destination of the data
5	Number of parameters
6	Command
7 onwards	Parameters

Example:

Number of parameters = 3

Command = &53 to read or &4B to write

Parameter 1	=	Track number
Parameter 2	=	Sector number
Parameter 3	=	&21 (specifies sector length of 256 bytes and 1 to be acted upon)

On Exit

0 in the last parameter address + 1 indicates a successful transfer. A failure is indicated by a disc error number.

9 Changing filing systems

Your computer can have several filing systems available other than the disc filing system. The following commands are all used to exit from the current filing system into the one named.

*TAPE3	300 baud cassette
*TAPE12	1200 baud cassette
*TAPE	1200 baud cassette
*NET	Econet filing system
*TELESOFT	The prestel and teletext system
*ROM	The cartridge ROM system
*DISK	Enters the filing system from one of the others
*DISC	Alternative spelling for above

Typing the command to enter the system you are already in has no effect.

10 Error messages

&CC Bad filename

This message appears if you enter a filename which is invalid, such as; longer than 7 characters, etc.

&D6 File not found

The Disc filing system could not find the named file in the specified drive/directories.

&C3 File locked

Access to the named file is locked. This error message is displayed when any attempt is made to overwrite or write to a locked file.

&C8 Disc changed

This error occurs if the computer detects that a disc has been changed while files on it are still open.

&CD Bad drive

This error means that the : (drv) part of the file specification was incorrect, e.g. ':' colon missing or drive number out of range 0 to 3.

&FE Bad command

This means that * was omitted or that the command name was not recognised as a Disc filing system command or utility.

&CE Bad directory

Means that the specified directory is not allowed, e.g. More than one character.

&CF Bad attribute

This error occurs if you use anything other than the letter 'L' with the `*ACCESS` command.

&CB Bad option

There are currently two 'option' commands `*OPT1` and `*OPT4`.
The error occurs if you type anything else besides 1 and 4 after `*OPT`.

&C6 Disc full

This indicates that there is not enough space on the disc to open (OPENOUT#) or save a file of the specified size.

&BE Catalogue full

The catalogue has enough space for 31 files. This error is produced if you attempt to enter more than 31.

&C4 File exists

This occurs if you try to rename a file with an existing filename.

&C9 Disc read only

This error occurs if you attempt to write to a disc which has the write-protection notch covered.

&C1 File read only

This error occurs if you try to write to a file opened for reading only, using OSFIND with A=40.

&C7 Disc fault NN at TT SS

If this error message occurs it means that the computer cannot read the disc. It implies that the disc is damaged, faulty, unformatted or of the wrong type, like an 80 track disc in a 40 track drive. NN is the error number TT is the track number SS is the sector number.

&C5 Drive fault NN at TT SS

This error means that the disc drive is probably faulty and needs attention.

&C0 Too many open files

This error occurs on attempting to open a sixth random access file. Five is the maximum allowed at once.

&CA Bad sum

Bad checksum. For each random access file opened a control block is held in memory. This includes a checksum. A bad sum indicates corrupt data in memory and possibly a memory fault.

&BF Can't extend

An attempt is made to extend a random access file when there is insufficient space immediately after it to do so.

&BD Not enabled

An attempt is made to use a use restricted command without typing `*ENABLE` immediately preceding it.

&C2 File open

This error occurs if you attempt to open a file which is already open. An intervening CLOSE is required between two OPENS referring to the same file. This error is also produced if you try to delete an open file with the commands `*DELETE`, `*SAVE`, `*BUILD` etc.

11 Technical information

18 bit addressing

The BBC disc filing system uses 18 bit addressing giving a range from &00000 to &3FFFF. This means that two bytes and two bits are required to store a complete address, like this:

&3FFFF is	11	1111	1111	1111	1111	in binary
	High bits	Middle bits		Low bits		

Each full address therefore consists of high, middle and low order bits. This is important to note because the bits of the address are not always stored consecutively in the catalogue. This is clearly shown by the way that the disc catalogue is loaded into memory.

Another important factor concerns the use of a second processor. If the top two bits of an address are set, e.g: &3----, the address is assumed to refer to the I/O processor.

Disc catalogue

Sectors 00 and 01 on the disc are reserved for the catalogue. The format of the catalogue is as follows:

Sector 00

&00 to &07	First 8 bytes of the 13 byte disc title
&08 to &0E	First filename
&0F	Directory of first filename
&10 to &1E	Second filename
&1F	Directory of second filename
	:
	:

Repeated up to 31 files.

Sector 01

&00 to &04	Last 5 bytes of the disc title.
&05	The number of catalogue entries multiplied by 8.
&06 (bits 0, 1)	Number of sectors on disc (2 high order bits of 10 bit number)
(bits 4, 5)	!BOOT start-up option

&07	Number of sectors on disc (8 low order bits of 10 bit number)
&08	First file's load address, middle order bits
&09	First file's load address, low order bits
&0A	First file's exec address, middle order bits
&0B	First file's exec address, low order bits
&0C	First file's length in bytes, middle order bits
&0D	First file's length in bytes, low order bits
&0E (bits 0, 1)	First file's start sector, 2 high order bits of 10 bit number
(bits 2, 3)	First file's load address, high order bits
(bits 4, 5)	First file's length in bytes, high order bits
(bits 6, 7)	First file's exec address, high order bits
&0F	First file's start sector, 8 low order bits of 10 bit number
	:
	:
	:

repeated for up to 31 files.

Note that the first 8 bytes in each sector contain miscellaneous information about the disc. Each subsequent block of 8 bytes contain information about the files, repeated for up to 31 files. The complete information about file 3 would be found in the fourth block of 8 bytes on sector 00 followed by the fourth block of 8 bytes on sector 01.

File system initialise and !BOOT

On pressing BREAK the MOS (machine operating system) seeks and initialises a filing system. It starts with the service ROM closest to the edge of the main printed circuit board. The first one will be initialised if just BREAK was pressed. If another key is held down while you press BREAK, the first file system which recognises the key will be initialised. If none recognise the key, the CFS (cassette filing system), is initialised.

Having initialised a filing system, if 'link 5' (See below) is unmade or if shift is *not* pressed and 'link 5' is made, then the start-up option of any associated device is examined. For options 1 to 3, the disc filing system will search for a file named !BOOT on the device and act according to the start-up option set.

In the case of the cassette filing system the start-up option of the ROM cartridge is examined as no start-up options are provided on cassette tapes.

link 5

There are 8 links at the right-hand front of the keyboard, inside the machine. Numbering 1 to 8 from left to right, link 5 determines the action of the selected file system. The options are described above.

The floppy disc drive parameters

Several different disc drives may be used with the BBC computer. The same 8 links on the front of the computer's keyboard (as mentioned above) are used to do this. Links three and four must be correctly set for each type.

Tandon disc drives with 4 msec. access require both links made.

Tandon and Shugart disc drives with 6 msec. access require 3 made 4 unmade.

MPI disc drives require link 4 made and 3 unmade.

Olivetti disc drives require both links unmade.

Important

The Tandon disc drives momentarily 'whirr' when you close the drive door, so as to centre the disc on the rotating cogs. Unfortunately they rotate faster than normal, so that if writing is commenced the catalogue is corrupted. Do not initiate a writing action until the drive has settled.

12 Filing system command summary

Command	(Minimum abbreviation, full-stop required)	Purpose
*ACCESS	(*A)	Locks or unlocks a file.
*BACKUP	(*BAC.)	Copies all information from one disc to another.
*BUILD	(*BU.)	Causes all subsequent keyboard entries to be stored in the named file.
*CAT	(*.)	Displays a disc catalogue.
*COMPACT	(*COM.)	Collects all files on a disc together into one contiguous sequence leaving a single block of free space.
*COPY	(*COP.)	Copies all specified files from one disc to another.
*DELETE	(*DE.)	Removes a single named file from the disc.
*DESTROY	(*DES.)	Removes specified files from a disc in a single action.
*DIR	(*DI.)	Changes the current set directory.
*DRIVE	(*DR.)	Changes the current set drive.
*DUMP	(*DU.)	Produces a hexadecimal listing of a file.
*ENABLE	(*EN.)	Allows the use of *BACKUP and *DESTROY
*EXEC	(*E.)	Reads a disc file byte by byte as if the bytes were being typed on the keyboard.
*HELP	(*H.)	Displays the file system commands with syntax guidelines.
*INFO	(*I.)	Displays information about specified files.

*LIB	(*LIB)	Selects the drive/directory for the library.
*LIST	(*LIST)	Displays a text file on the screen with line numbers.
*LOAD	(*L.)	Reads a file from disc to memory.
*OPT 1	(*O.1)	Switches screen messages which accompany disc accesses on or off.
*OPT 4	(*O.4)	Specifies the auto-start option of a disc, relating to a file named :0.$.!BOOT.
*RENAME	(*RE.)	Changes a filename.
*RUN	(*R.)	Runs a machine code program.
*SAVE	(*S.)	Saves a specific part of memory to the disc.
*SPOOL	(*SP.)	Transfers all text subsequently displayed on the screen into a specified file.
*TITLE	(*TI.)	Changes the title of a disc.
*TYPE	(*TY.)	Displays a text file on screen with line numbers.
*VERIFY	(*V.)	Checks legibility of every sector on a disc.
*WIPE	(*W.)	Removes specified files from the disc after confirmation for each file meeting the given specification.

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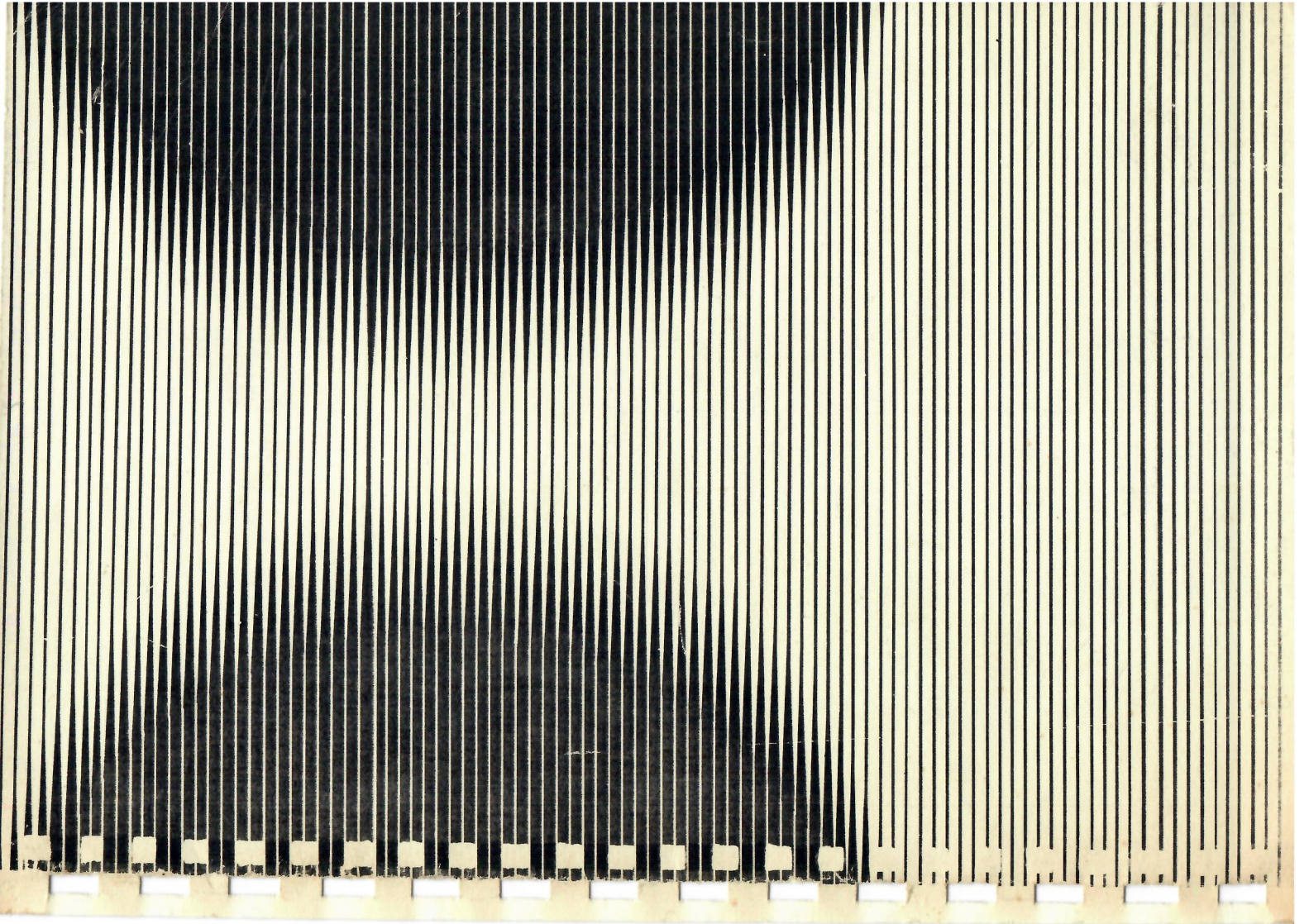
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